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BATHYAL DECAPOD CRUSTACEANS OF THE CATALAN SEA (NORTHWESTERN MEDITERRANEAN)

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Résumé : ***Crustacés décapodes bathyaux de la Mer Catalane (Méditerranée nord-occidentale).*** On a étudié les crustacés décapodes capturés dans les fonds bathyaux de la Mer Catalane (Méditerranée nord-occidentale à partir de 39 chalutages faits entre les isobathes 1 000 et 2 000 m. On a identifié 21 espèces de crustacés décapodes. Les espèces les plus communes de l'aire étudiée ont été *Munida tenuimana, Acanthephyra eximia, Aristeus antennatus, Nematocarcinus exilis, Stereomastis sculpta* et *Pontophilus norvegicus. Munidopsis tridentata* (Anomura : Galatheidae) est citée pour la première fois en Méditerranée. La plupart des espèces appartiennent aussi à la faune nord-atlantique. Bien que beaucoup d'espèces puissent être aussi capturées dans l'horizon bathyal moyen, on a détecté de nettes différences entre ce dernier horizon et l'horizon bathyal profond ici étudié, montrant ainsi la nécessité de différencier ces deux horizons (moyen et profond) dans la communauté des vases bathyales.

Mots-clés : Crustacés, Décapodes, zone bathyale, Mer Méditerranée.

Summary : The decapod crustaceans captured during a faunistic survey carried in the Catalan Sea bathyal basin (northwestern Mediterranean) are studied in the present paper. Thirty-nine deep-water trawls were performed between 1 000 and 2 000 m isobaths. Twenty-one decapod crustacean species were identified. The commonest species were *Munida tenuimana, Acanthephyra eximia, Aristeus antennatus, Nematocarcinus exilis, Stereosmastis sculpta* and *Pontophilus norvegicus. Munidopsis tridentata* (Anomura : Galatheidae) is recorded for the first time in the Mediterranean. Most species also belong to the North-Atlantic fauna and, even though most of them can also be found in the middle bathyal horizon, the fauna surveyed presents clear differences from that of the latter zone, providing thus evidence to differentiate a middle and a lower assemblages within the deep bathyal mud community.

Key-words : Crustacea, Decapoda, Bathyal zone, Mediterranean Sea.

The faunistic composition and structure of the Mediterranean deep-water ecosystems is poorly known (Perès, 1985), even though macrofauna constitutes the main fraction of the benthic biomass within the bathyal ecosystem (Haedrich and Rowe, 1977 ; Smith and Hamilton, 1983). Thus, Fredj and Laubier (1985) suggested the exploration of the less known areas and the study of the composition and function of the soft-bottom deep-water Mediterranean ecosystem below 1 000 m depth.

The faunistic composition of the shelf and upper slope in the North-West Mediterranean is relatively well known. However, as the appropriate technology to sample macrofauna on deep-water bottoms is not yet fully developed, all the efforts to study deep-water crustaceans in the area stopped at the barrier of 800-900 m depth (Zariquiey Alvarez, 1968 ; Sarda and Palomera, 1981 ; Abello et al., 1988). The faunistic study of the decapod crustaceans captured in several deep-water trawls performed at more than 1 000 m depth during four exploratory cruises made in the northwestern Mediterranean constitutes the main objective of the present paper.

MATERIAL AND METHODS

We identified the decapod crustaceans captured in thirty-nine trawls performed during four research cruises aimed at the prospection of the macrofauna inhabiting the bathyal northwestern basin of the Mediterranean. The area sampled covered the Catalan Sea, between the coasts of Catalonia (North-East Spain) and the Balearic Islands (fig. 1). All the cruises were made on board R/V "Garcia del Cid". Eight trawls were made in June 1983, sixteen in September 1983, eleven in June 1984, and four in September 1985. All of them were performed during the day between 1 000 and 2 000 m isobaths.

A modified Agassiz trawl was used in the cruises made in June and September 1983 and in June 1984. It consisted of a rigid steel frame 2.1 m wide and 1.2 m high to which a net of 6 mm mesh size was attached (Allué et al., 1985). The gear used in September 1985 was a deep-water Marinovich trawl with doors, with a 6 mm codend mesh size.

Carapace length was measured from the orbit, or from the right frontal sinus in brachyuran crabs, to the dorsal posterior edge of the carapace.

The Shannon-Wiener index (Margalef, 1974) was used to calculate the diversity of the samples.

RESULTS

Decapod crustaceans were captured in thirty-six out of the thirty-nine trawls performed. Twenty-one species were identified (tab. 1) : four Dendrobranchiata, eight Caridea, one Thalassinidea, two Palinura, two Anomura, and four Brachyura. Table 2 shows the number of trawls in wich each species occured, together with the depth range observed.

The diversity of the samples (fig. 2) did not show any evident trend in relation to depth. The highest values

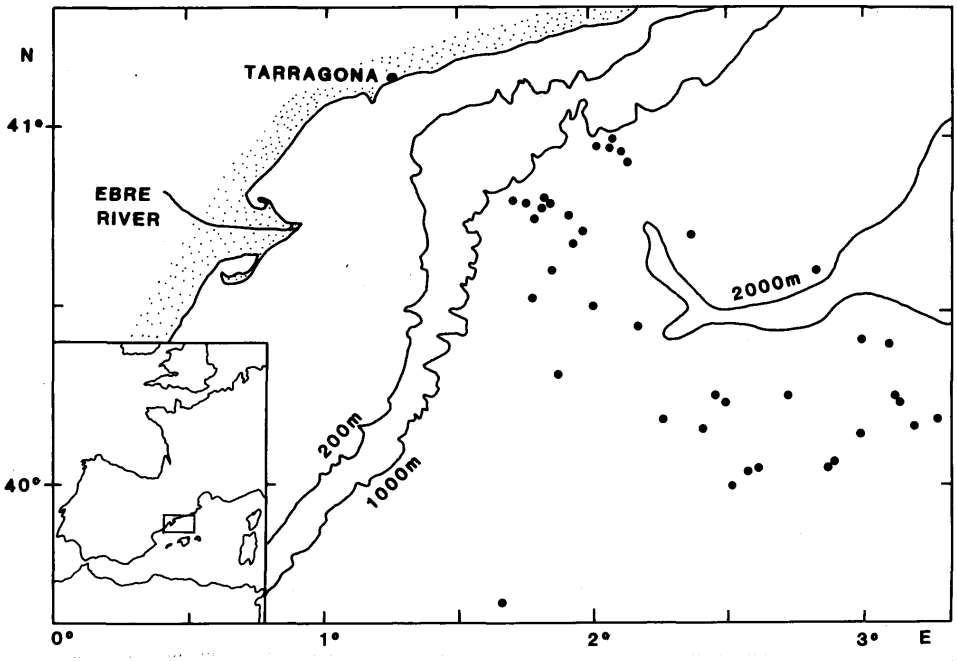

Figure 1. Position of the deep-water trawls made on the Catalan Sea bathyal bottoms (> 1 000 m depth) (North-West Mediterranean) during the sampling programs (1983-1985).

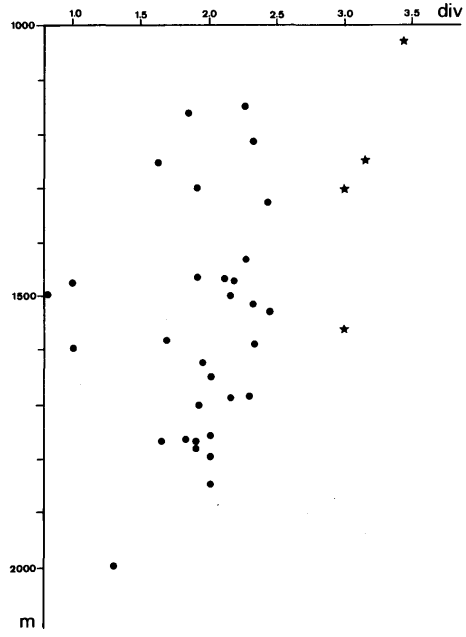

Figure 2. Distribution of diversity values (Shannon-Wiener index) plotted as a function of depth. Points correspond to trawls made in June and September 1983 and June 1984 ; stars, to those made in September 1985.

observed were found in the samples taken in September 1985 in which a different, more effective, gear was used.

BENTHIC SPECIES

Among the benthic shrimps, the only common species found was the crangonid *Pontophilus norvegicus*, previously recorded in the area by Forest (1965) and Abello and Valladares (1985). Sizes of the specimens captured were comprised between 6.5 and 11.5 mm. A female of the crangonid *Pontocaris lacazei* was captured in a trawl made between 1 020 and 1 040 m, constituting the deepest record of the species in the northwestern Mediterranean.

The thalassinid *Calocaris macandreae* was only recorded in three of the hauls, possibly due to the burrowing habits of the species (Buchanan, 1963).

The polychelid *Stereomastis sculpta* was one of the commonest species of the area. Male sizes were comprised between 13.4 and 24.2 mm ; female sizes between 16.5 and 32.8 mm. The present captures constitute the first record of the species in the Iberian Mediterranean waters.

Polycheles typhlops was not as common as *S. sculpta*. Sizes ranged between 16.2 and 25.5 mm in males, and between 12.2 and 31.5 mm in females. Ovigerous females

Suborder Dendrobranchiata

Family Aristeidae

Aristeus antennatus (Risso, 1816)

Gennadas elegans (S.I. Smith, 1882)

Family Sergestidae

Sergia robusta (S.I. Smith, 1882)

Sergestes arcticus Kröyer, 1855

Suborder Pleocyemata

Infraorder Caridea

Family Oplophoridae

Acanthephyra eximia S.I. Smith, 1884

Acanthephyra pelagica (Risso, 1816)

Family Nematocarcinidae

Nematocarcinus exilis (Bate, 1888)

Family Pasiphaeidae

Pasiphaea multidentata Esmark, 1866

Pasiphaea sivado (Risso, 1816)

Family Pandalidae

Plesionika acanthonotus (S.I. Smith, 1882)

Family Crangonidae

Pontophilus norvegicus (M. Sars, 1861)

Pontocaris lacazei (Gourret, 1887)

Infraorder Thalassinidea

Family Axiidae

Calocaris macandreae Bell, 1846

Infraorder Palinura

Family Polychelidae

Polycheles typhlops Heller, 1862

Stereomastis sculpta (S.I. Smith, 1880)

Infraorder Anomura

Family Galatheidae

Munida tenuimana G.O. Sars, 1872

Munidopsis tridentata (Esmark, 1856)

Infraorder Brachyura

Family Homolidae

Paromola cuvieri (Risso, 1816)

Family Portunidae

Macropipus tuberculatus (Roux, 1830)

Family Geryonidae

Geryon longipes A. Milne Edwards, 1881

Family Majidae

Dorhynchus thomsoni Thomson, 1873

Table 1. Decapod crustaceans captured in the northwestern Mediterranean bathyal basin, between the coasts of Catalonia and the Balearic islands, between 1 000 and 2 000 m (1983-1985).

Table 2. Bathyal decapod crustaceans from the Catalan Sea in order of decreasing number of occurrences in the samplings. The total number of trawls made is 39. For every species, percentage occurence and the observed bathymetric range are also presented. Bathypelagic species have been marked with *.

Species	No. occurrences	%	Depth (m)
Munida tenuimana	30	76.9	1020-1871
Acanthephyra eximia	27	69.2	1020-2011
Aristeus antennatus	26	66.7	1020-1815
Nematocarcinus exilis	25	64.1	1243-2011
Stereomastis sculpta	25	64.1	1196-2011
Pontophilus norvegicus	18	46.2	1020-1815
* *Sergia robusta*	15	38.5	1020-1871
Geryon longipes	12	30.8	1020-1635
* *Gennadas elegans*	10	25.6	1020-1790
Polycheles typhlops	10	25.6	1020-1871
* *Pasiphaea multidentata*	9	23.1	1020-1871
* *Acanthephyra pelagica*	8	20.5	1220-1790
Plesionika acanthonotus	7	17.9	1020-1485
* *Sergestes arcticus*	5	12.8	1020-1616
Calocaris macandreae	3	7.7	1020-1322
Dorhynchus thomsoni	3	7.7	1020-1336
* *Pasiphaea sivado*	1	2.6	1450-1500
Pontocaris lacazei	1	2.6	1020-1040
Munidopsis tridentata	1	2.6	1545-1580
Paromola cuvieri	1	2.6	1020-1040
Macropipus tuberculatus	1	2.6	1430-1433

measuring from 28.0 to 29.4 mm were captured in September 1985.

The anomuran *Munida tenuimana* was found to be the commonest species on the bottoms surveyed. Male sizes were comprised between 8.4 and 22.5 mm ; female sizes between 8.5 and 22.0 mm. Three females and one male were found to be parasitized by a rhizocephalan.

One individual of the galatheid crab *Munidopsis tridentata* (Esmark, 1856), was captured in a trawl performed between 1545 and 1580 m (fig. 3). The area of distribution of the species comprises the deep North Atlantic from Norway to the Azores and Cabo Verde islands (Zariquiey Alvarez, 1968). As the present individual constitutes the first record of the species in the Mediterranean, we proceed

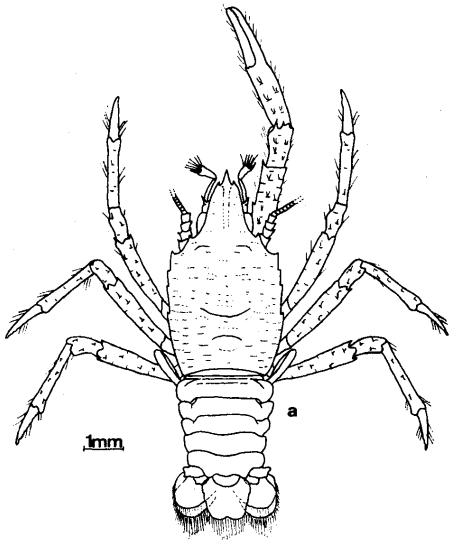

Figure 3. *Munidopsis tridentata* (Esmark, 1856). Juvenile female (carapace length = 3.6 mm) captured between 1545 and 1580 m depth.

to briefly describe the specimen, a juvenile female.

The edges of the rostrum are subparallel and end by three points, the central being the longest. The ocular stalks are subcylindrical and can be seen under the edges of the rostrum. The cornea lacks pigmentation. The carapace is rectangular, with smooth grooves, except the subcervical. The lateral edges of the carapace are slightly convex ; they bear three spines ahead of the subcervical groove and one immediately behind. The frontal edge of the carapace is oblique and largely extended from the base of the rostrum to the first antero-lateral spine. One extraorbital spine occurs on this frontal edge. The abdomen lacks spines. The second, third and fourth peraeopods have a row of small teeth on the upper edge of the carpus and merus. The fifth peraeopod is rudimentary. The right cheliped is as long as the carapace (the left cheliped is missing in the present specimen). Pleopods are not fully developed.

Among the brachyuran crabs, *Geryon longipes* was the commonest species in the area. Sizes ranged from 39.0 to 58.2 mm in males, and from 16.8 to 31.9 mm in females. *Dorhynchus thomsoni,* a deep-water majid crab, was only recorded in three hauls. One individual of *Paramola cuvieri* was captured in a trawl made between 1 020 and 1 040 m, constituting the deepest record of the species in the Iberian Mediterranean.

A female *Macropipus tuberculatus* measuring 27.0 mm carapace length was captured in a trawl made between 1 430 and 1 433 m ; the previous deepest known record of the species being 834 m (Almaça, 1985). Consequently, the present capture increases considerably the bathymetric range of the species. Nevertheless, it must be considered an exceptional and isolated individual record, as the species in the Catalan is mainly found between 100 and 500 m (Abelló et al., 1988).

NEKTOBENTHIC SPECIES

The peneid shrimp *Aristeus antennatus,* was the third most common species in the area surveyed. Female sizes were comprised between 19.0 and 54.0 mm ; male sizes between 19.7 and 32.5 mm.

Nematocarcinus exilis (fig. 4) was also quite commonly recorded and was identified following the criteria of Crosnier and Forest (1973). However, some remarks must be taken into account. In most individuals, the rostrum points slightly upwards, even in the smallest individuals, a character close to *N. ensifer.* However, the rest of characters match *N. exilis ;* shape and position of the rostral teeth, and of the third and fifth abdominal segments. Size were comprised between 8.6 and 17.6 mm. The present captures constitute the first record of the species in the Iberian Mediterranean.

The caridean shrimp *Acanthephyra eximia* was the second most common species of the area, after *M. tenuimana.* Ovigerous females ranging from 27.6 to 37.5 mm carapace lenght were captured in June 1984.

Sizes of the caridean shrimp *Plesionika acanthonotus* ranged from 10.0 to 16.0 mm. Ovigerous females were captured in June 1984 and September 1985, ranging in size from 13.4 to 15.9 mm.

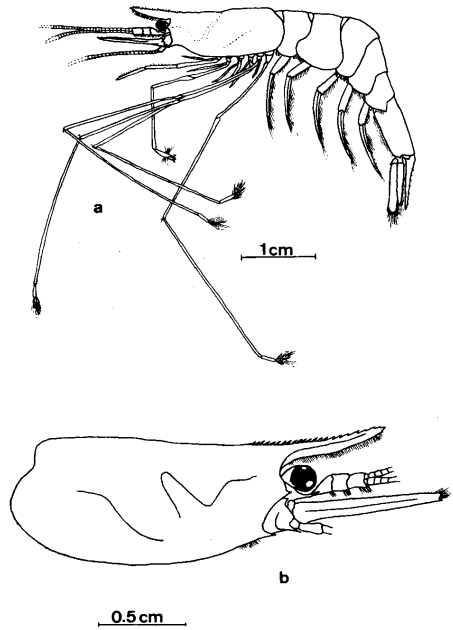

Figure 4. *Nematocarcinus exilis* (Bate, 1888). Female, carapace length = 15.5 mm. a) General aspect, lateral view ; b) carapace, lateral view.

BATHYPELAGIC SPECIES

Several bathypelagic species were captured in the present surveys ; *Gennadas elegans, Sergia robusta, Sergestes arcticus, Acanthephyra pelagica, Pasiphaea multidentata,* and *Pasiphaea sivado.* We cannot be completely sure whether these species were actually caught while on the bottom, or whether they were captured while the gear was being pulled up. However, many such species can be found on the bottom at similar depths, especially during the day, as they perform important vertical day-night migrations (Forest, 1985 ; Franqueville, 1971 ; Froglia and Giannini, 1982). With the exception of *S. arcticus* and *P. sivado,* the rest of species were quite often captured in the present surveys, especially *S. robusta* and *G. elegans.*

DISCUSSION

The present results constitute the first contribution to study the decapod crustacean fauna below 1 000 m depth in the Catalan Sea. The nature of the exploratory methodology used did not allow however quantification of the macrofauna of the area. The bathyal decapod crustacean fauna of the Catalan Sea appeared to be quite diverse : twenty-one different species were captured. Not only several have recorded for the first time in the area, but the known depth distribution of many of them has been broadly enlarged.

In addition to typically benthic or epibenthic species, several bathypelagic species were also captured. The reliability of the occurence and of the depth range stated (table 2) may have been affected by the sampling procedures, as these species could have been captured while the gear was being pulled up. However, as all trawls were made by day, and the present species perform important vertical migrations (Franqueville, 1971 ; Froglia and Giannini, 1982), some of them could have actually been taken on the bottom in some trawls.

It is important to remark the first Mediterranean record of *Munidopsis tridentata.* To date, only one species of the genus, *Munidopsis marionis* (A. Milne Edwards, 1982), had been recorded in the Mediterranean (Carpine, 1970).

From the biogeographical point of view, the Catalan Sea belongs to the septentrional sector of the western Mediterranean Sea (Peres and Picard, 1964), which is characterized by the rarefaction of the fauna of subtropical origin and by the presence of species characteristic of cold waters. Many of the species captured belong to the North Atlantic fauna as well (e.g. *Pontophilus norvegicus, Munidopsis tridentata, Munida tenuimana, Polycheles typhlops, Stereomastis sculpta,* etc.). Carpine (1970) also stated that there is a great similitude between the bathyal populations of the Western Mediterranean and their equivalent in the North Atlantic. The present results provide thus further evidence for the deep western Mediterranean to be considered an enclave of North Atlantic cold water species, after the climatic and oceanographic changes following the glaciations.

The high diversity and number of species found in the area may be mainly attributed to the high hydrographical stability of the deep-water mass. Temperature and salinity are fairly constant throughout the year (temperature : 12.7 - 12.9° C ; salinity : 38.40 - 38.50 ppt) (Salat and Font, 1985), and it is a well known fact that diversity tends to increase with increasing environmental stability (Margalef, 1974). The higher diversity values detected in September 1985 can be clearly attributed to a higher efficiency of the gear used.

Peres (1985) subdivided the Mediterranean bathyal mud assemblage into three zones of different depths. The upper zone or horizon closely corresponds to the upper-slope assemblage detected by Abelló et al. (1988) in the area (approx. 200 to 400 - 500 m depth) ; the middle zone corresponds to the lower-slope assemblage (approx. 400 - 500 to 800 - 1 000 m), whereas the lower zone corresponds to the deepest bathyal plain studied here. Both upper and middle zones of Pérès' Mediterranean bathyal mud assemblages represent in the area quite different faunistic assemblages, associated to different environmental characteristics (Abelló et al., 1988) ; pelagic and bathypelagic species are practically the only species who share both habitats. However, the faunistic composition below 1 000 m is not very different from that of the middle bathyal zone. Only three species *(Stereomastis sculpta, Nematocarcinus exilis,* and *Munidopsis tridentata)* out of the twenty-one captured, had not been previously recorded in the northwestern Mediterranean middle bathyal horizon.

Several common species may be considered characteristic species of this deep bathyal area of the North-West Mediterranean, as they do not occur on the upper-slope horizon of the bathyal assemblage (Abelló et al., 1988), namely *Stereomastis sculpta, Nematocarcinus exilis, Munida tenuimana, Pontophilus norvegicus, Geryon longipes, Aristeus antennatus,* and *Acanthephyra eximia.*

We may thus consider the fauna of the deep bathyal plain of the Catalan Sea, as belonging to the lower horizon of the bathyal mud assemblage (Pérès, 1985). Most species share both middle and lower horizons. However, some of them are only found in the lower horizon or are most commonly found in it, providing thus evidence to support the characterization of the middle and lower horizons of the bathyal assemblage.

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